

California High-Speed Train Project



TECHNICAL MEMORANDUM

Summary Description of Requirements and Guidelines for: Heavy Maintenance Facility (HMF), Terminal Layup/Storage & Maintenance Facilities & Right-of-Way Maintenance Facilities TM 5.3

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1.0 INTRODUCTION

Based on a service design driven by the CHSTP ridership demand forecast, an operating plan was developed to define train schedules and estimate the number of train-sets for the CHSTP rolling stock fleet. In order to support the commissioning activities, layup/storage and maintenance program requirements (Levels I, II, III, IV, V), and ultimate retirement for this estimated fleet size, concepts were developed for the daily Terminal Layup/Storage and Maintenance Facilities (TSMF) and a Heavy Maintenance Facility (HMF) with the requisite tracks and shop buildings. In addition, right-of-way maintenance requirements were examined, and a description of a “typical” Maintenance of Way Facility (MOWF) configuration was developed and recommendations for approximate locations along the high-speed train system alignment were identified.

Preliminary guidelines and criteria applicable to the design of the TSMF, HMF and MOWF have been prepared. The size and configuration of these facilities were estimated based on defining the capabilities and functional requirements necessary to support the activities critical to efficiently maintaining and safely operating the CHSTP rolling stock fleet and physical plant. These capabilities and requirements were largely derived from a review of best practices and programs used on similar high-speed train (HST) systems around the world, including France, Korea and Japan.

2.0 SUMMARY–CONCEPT OF ROLLING STOCK MAINTENANCE PROGRAM

A brief overview of the maintenance program expected to be carried out at the CHSTP, TSMF and HMF is described below:

- *Level 1 – In Service Monitoring:* daily testing and diagnostics of certain safety sensitive apparatus on the train in addition to automatic on-board and on-ground monitoring devices.
- *Level 2 – Examinations in Service:* inspections, tests, verifications and “quick” replacement of certain components on the train. Examples include inspection and maintenance tasks associated with the train’s running gear, bogies, underbody elements and pantographs.
- *Level 3 – Periodic Inspections:* part of planned preventive maintenance program requiring specialized equipment and facilities. Examples include: a) examination of interior fittings and all parts of the train in the immediate environment of the passengers, b) in depth inspection of axles and underbody components, critical to train safety by identifying and repairing any condition in the running gear and connecting components, c) wheel condition diagnostics and re-profiling (wheel truing).
- *Level 4 – Overhauls (HMF only):* part of the planned life cycle maintenance program requiring a specialized heavy maintenance shop with specific heavy duty equipment. Activities include the complete overhaul of train components replaced during Level I, II and III. In addition, this a full complement of heavy maintenance is completed on each trainset every 7 to 10 years (30 days per trainset) as well as mid-life overhauls which are performed on each trainset every 15 to 20 years (45 days per trainset).

Level 5 – Rolling Stock Modifications & Accident Repair (HMF only): Activities to support installation of a major modification to the design of the trainset for purposes of improving safety, reliability and passenger comfort. In addition, this category includes repair to a trainset which has “suffered” significant damage.

3.0 COMMISSIONING OF ROLLING STOCK

The five levels of the HST Maintenance Program previously described, define the basic structure of the HST Maintenance Program. In addition to the in service maintenance regimen, the purpose of the HMF is presented in the Technical Memorandum, Terminal and Heavy Maintenance Facility Guidelines dated August 2009. The HMF is assumed to be used during the pre-revenue service period for the assembly, testing, acceptance, and commissioning of the HST System new rolling stock fleet. Implementation of the testing, acceptance and commissioning activity would also require a main line test track between 80 and 105 miles in length connected directly to the HMF. The HMF would also be used for decommissioning or retirement of equipment from the system to make way for the next generation of rolling stock.

4.0 RIGHT-OF-WAY MAINTENANCE

Adequate space will be required to “park” on-track right-of-way maintenance equipment, store maintenance of way material inventory and replacement parts, and support a “headquarters” and staging area for HST System “sub-division” maintenance personnel. The locations that support an effective Maintenance of Way program strategy are envisioned to be located within close proximity to Gilroy, Merced, Visalia, Bakersfield, and Palmdale for Phase I, with Stockton, City of Industry and Temecula added later for the Full System Build-Out. The selection of right-of-way maintenance facilities will be based on servicing a track distance of 75 miles in each direction from the maintenance site for a total coverage of 150 miles. This is to accommodate the time for equipment traveling at 60 mph to reach locations along the alignment needing maintenance during the five hour non-revenue period.

The site for each MOWF must be located immediately adjacent to the main line trunk of the HST System and be connected to the main line with a standard turnout. Also required is effective connectivity to the highway road network and access to utilities including water, gas, electricity, sewer and communications.

Based on a conceptual rendering of a “typical” MOWF as depicted in the attached schematics entitled “MOWF Concept Plan”, Alternative A (wide configuration) TM 5.2-A and Alternative B (narrow configuration) TM 5.2-B the size of these facilities would require a land parcel “footprint” of between approximately 24 to 26 acres each, inclusive of roadways and parking.

5.0 OPERATIONS CONTROL CENTER

A provision for a train operations control center has been assumed within the HMF “compound”, on a second level of the HMF building. Space for employee parking, pedestrian access/egress and appropriate bathroom and lunchroom facilities has been included. However, the operations control center can be located at any place along the system. Utilizing the second level of the HMF building will allow space for the operations control center without increasing the foot print of the HMF building or the additional cost of a separate building.

6.0 ROADWAY ACCESS AND PARKING TSMF & HMF

A conceptual layout of the roadways and parking areas needed to support the Terminal Storage Maintenance Facilities (TSMF) and Heavy Maintenance Facility (HMF) was developed based on the following assumptions:

Access and Circulation

- Access/egress primarily controlled at a single gated entry point
- A two-way circulation road, 24 feet wide, would follow the interior perimeter of each facility

- For the HMF, a 50-foot wide asphalt “apron” would surround the main shop building to provide access for emergency vehicles to any point around the structure
- Roadways to provide access to specific locations in the building(s) and yard(s) would be considered, as shown on the conceptual schematics
- For the HMF, a pedestrian “bridge” over the train yard tracks would be used to connect the employees’ parking lot on one side of the yard tracks and the main shop building on the other side

Parking:

- At the HMF, up to 1500 HMF rolling stock shop employees are estimated to be accommodated during “peak shifts”, including consideration of overlapping departure and arrivals of personnel. It is assumed that approximately twenty percent of employees would use public transportation or will ride share, resulting in an eighty percent automobile mode share for employee work trips. The public transportation share would be employees commuting via bus or a possible employee train stop off the HST system
- It is estimated that the parking demand for HMF rolling stock shop maintenance employees would require space for approximately 1200 vehicles based on the estimate of eighty percent automobile mode share ($1500 \times 80\% = 1200$).
- 150 parking spaces are assumed to be provided in proximity to the facility for Management and Administrative Personnel, Visitors, Deliveries and Priority Parking.
- It is expected that crew, rolling stock preparation personnel and some of the train yard employees would park their automobiles near the yard tracks. Spaces would be provided for 50 crew, 50 rolling stock preparations and 150 yard support employees.
- It is assumed that Right-of-Way Maintenance employees for a sub-division of the HST System would be located in the HMF “compound”. An area of approximately 350,000 square feet for “lay-down”, staging and storage area would be provided with 400 spaces for Right-of-Way Maintenance equipment, Right-of-Way Maintenance employees and the personnel who would operate and maintain the Train Washer and Automatic Wheel Inspection Station.

7.0 “OTHER” REQUIREMENTS

In addition to the items that are described above and depicted on the concept schematics (noted in section 8.0), there are other requirements that will have to be provided to support the operation of these TSMF and HMF Facilities:

- Connectivity provision for the Facilities roadways (as shown on the schematics) to the local road and highway network providing access/egress for (examples):
 1. Employees commuting by automobile
 2. Public transportation vehicles (local buses)
 3. Deliveries of materials and supplies (using heavy trucks)
 4. Emergency response personnel such as the fire department and medical teams
- Connectivity provision to the electric power grid to power the buildings, shops and trains. These facilities are currently described at a concept level and the requirements will be clarified as design progresses.
- For the HMF, it is desirable to build a sub-station within the “compound” that would support power needs for:

5. Train storage
 6. Train movements
 7. HMF shops' operations
 8. All other HMF buildings and facilities
- For the HMF, it is expected that this approach would require a new utility service from the nearest utility distribution line. In this case, it is estimated that ~13.8kV lines would not be sufficient and that a ~34.5kV service into a split step down facility is preferred. The catenary would be (isolated from the main line) supplied by a standard 1x25kV transformer, and the HMF would be fed from standard transformers which could distribute 480v 3ph throughout the facility
 - Connectivity to the water system, and both storm and sanitary sewer systems for personnel and industrial purposes. These facilities will provide train washing and toilet servicing for the rolling stock fleet. Water supply would also be required for employee locker room/bathroom facilities, interior building maintenance activities, and commercial food services needs.
 - Consideration for refuse removal services
 - Zoning for heavy industrial

8.0 FACILITIES SITE LOCATION CRITERIA

It is important that each of these facilities be located immediately adjacent to the HST System main line tracks and connected directly to these (main line tracks) with a 110 mph turnout and two connecting tracks (i.e. "double track") of approximately 3,696 feet on both ends of each facility. The connecting tracks will transition to become the slow speed (15 mph) lead tracks within each facility.

In addition to proximity and connectivity to the HST System main line tracks, the site of the Terminal Storage Maintenance Facilities (TSMF) should be such that the distance between the TSMF and the Terminal Stations is minimized. The preferred distance is up to 1.5 miles, the desirable distance is from 1.5 to 3.0 miles and the exception is further than 3.0 miles.¹ Terminal Storage Maintenance Facilities are required for the terminus stations or end points of the system at San Francisco, Los Angeles, Anaheim and Merced for Phase 1 with additional TSMF at San Diego and Sacramento for the Full Build-Out. Consideration has been given to a possible combined TSMF for Los Angeles and Anaheim. More detailed information on the train storage requirements is presented in Technical Memo 4.2, Phase 1 Service Plan, dated November 22, 2008, and Technical Memo 4.3, High-Speed Train Service Plan — Full Build Network with Links to Sacramento and San Diego, dated February 1, 2009.

The desirable site for the Heavy Maintenance Facility is that it be located centrally on the HST System between Merced and Bakersfield and, as previously described in Section 3.0 be able to accommodate direct connection with 79 to 105 miles of "high-speed" main line "test" track for testing, acceptance and commissioning of the new HST fleet. Being central is important. Merced-Bakersfield is the "Central Part" of the system, is part of the trunk line (Anaheim-SF), and has the ability to include the high-speed test track (no other part of the system meets these criteria). The required length of this test track is based upon current high-speed train manufacturers' recommendations for testing and commissioning which

¹ For illustration purposes, the potential effect of extending the proximity of a TSMF from an average of 3 miles to an average of 10 miles for the terminal stations (San Francisco, Sacramento, Los Angeles, Anaheim and San Diego) assumed in the CHSTP Full Build-Out with extensions to Sacramento and San Diego was estimated to be approximately 480,000 additional "dead-head" miles annually. Dependent on the results of further study and analysis of detailed train-set cycles, this would result in a potential requirement for one or two additional train-sets at a cost of \$30M to \$35M per train-set (\$60M to \$70M for two). Furthermore, Operations and Maintenance (O&M) costs would increase due to additional propulsion power consumption and additional crew and staffing requirements.

includes a protocol for sustained running for ten minutes at either up to 250 mph. Train operations at these speeds require a tangent (straight) alignment for the aforementioned distances.

The rationale for locating the HMF between Merced and Bakersfield is directly associated with international HST best practices and experience obtained from the start-up and implementation of other HST systems including KTX in Korea. It was determined that it is critical for the HMF to be activated prior to delivery of new train-sets for purposes of (potential) assembly and to have all of the functional requirements of the facility available during the required testing, acceptance and commissioning of the fleet. The testing procedures require that each train achieve a test speed greater than the in-revenue-service operating speed; for the CHSTP that speed range is between 223 mph (minimum) and 242 mph (recommended/preferred) and that this speed be sustained for a duration of ten minutes for each test run. Consequently, in order to provide track infrastructure capable of meeting these requirements, the maximum operating track speed must be 223 mph / 242 mph and the length of the “test track” must be between 79 miles (for 223 mph scenario) and 104 miles (for 242 mph scenario).

In addition, at the least this track must be directly connected to the HMF and HST international industry best practice recommends that for new HST systems, that the test track be fully “commissioned and tested” main track to replicate actual operating conditions. Based on this criteria, the Merced to Bakersfield segment conforms with the maximum test speed and track length requirements; other CHSTP sections such as the San Francisco to San Jose segment is being designed for a maximum speed of 125 mph (and is approximately 60 miles in length) and the Los Angeles to Anaheim segment is being designed for a maximum speed of 110 mph (and is approximately 30 miles in length).

A more detailed discussion of the standard testing, acceptance and commission procedures for high-speed train sets is presented in Technical Memorandum, Terminal and Heavy Maintenance Facility Guidelines dated August 2009.

9.0 ESTIMATED SPATIAL REQUIREMENTS

Based on a conceptual rendering of these facilities as depicted in the attached schematics entitled “HMF Concept Plan”, TM 5.1-A, the TSMF and HMF facilities require the following land parcel “footprints” range (depending on the shape of the land parcel), inclusive of buildings, outdoor service areas, storage, roadways and parking:

- Merced to Bakersfield Heavy Maintenance Facility Concept Plan, TM 5.1A, 154 Acres
- Los Angeles Storage Yard and Maintenance Facility Concept Plan, TM 5.1B, 62 to 83 Acres
- San Francisco Storage Yard and Maintenance Facility Concept Plan, TM 5.1C, 90 to 108 Acres
- Anaheim Yard and Maintenance Facility Concept Plan, TM 5.1D, 52 to 74 Acres
- Sacramento Yard and Maintenance Facility Concept Plan, TM 5.1E, 54 to 76 Acres
- San Diego Yard and Maintenance Facility Concept Plan, TM 5.1F, 70 to 93 Acres
- Los Angeles / Anaheim (combined TSMF) Yard and Maintenance Facility Concept Plan, TM 5.1G, 88 to 105 Acres